CHAPTER IV

EXPERIMENTAL PROCEDURE

SERIES I Dynamometer calibration

The dynamometer was fixed on a steel table as shown in Fig 4.1 and connected to the strain gauge bridge circuit as shown in Fig.3.8 The gauge factor was set at 1.87 , the supply switched on & the measuring dial set to zero before depressing the detector key & balancing the bridge using the apex resistor. For vertical force component calibration, the selector switch was turned to the vertical circuit for measuring the upper and lower strain gauges, load being applied by an L-shaped piece of material with wire rope & hanger weights attached. A pulley was used to produce the horizontal load. The vertical load was increased in steps of 11.02 lbs (5 k.g.) to 100 lbs and at each step of load, readings were taken from the measuring dial by turning it till the bridge balanced.

For the horisotal force calibration, the selector switch was set for horizontal circuit which measured the two strain gauges attached on the vertical surfaces of the measuring bar, & the same procedure repeated.

SERIES II Test for cross-coupling

The apparatus was set up as for calibration. It was first tested for cross coupling of vertical load to horizontal load reading because the vertical load is larger than the horizontal load. The horizontal load was kept constant at 22.5 lbs. and the vertical load increased in steps of 11.02 lbs. (5 k.g.) to 100 lbs. At each step of vertical load the horizontal readings were taken, & plotted against the vertical

Fig. 4.1 Dynamometer calibration

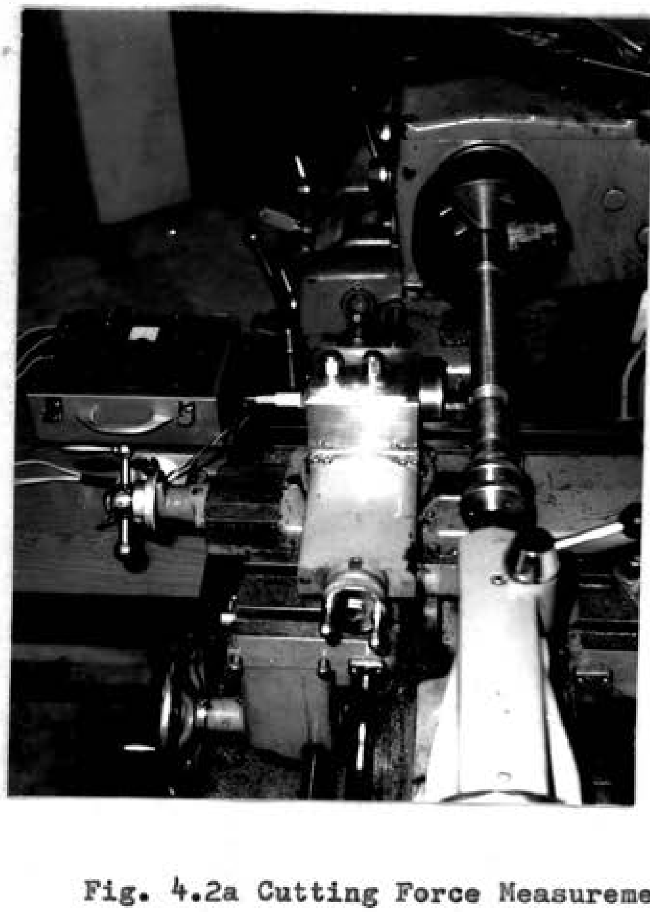

Fig. 4.2a Cutting Force Measurement

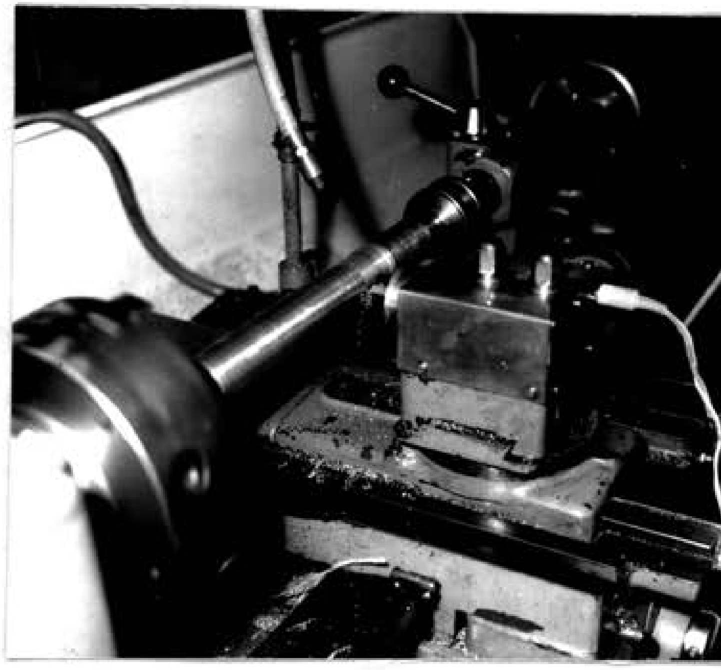

Fig. 4.2b Dynamometer on test

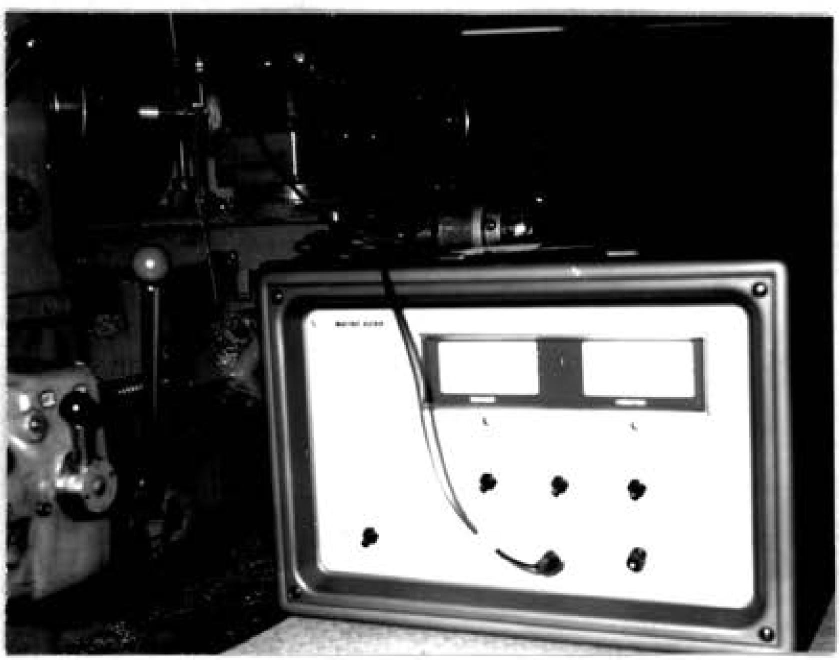

Fig. 4.3 Wayne-Kerr vibrationmeter

load, a linear curve being obtained. The slope of the curve is the cross coupling of vertical load to horizontal reading. Also the cross coupling of horizontal load to vertical reading was tested by the same procedure.

SERIES III Metal cutting tests

a. Constant feed test The dynamometer was clamped on the saddle of the lathe by two clamping screws, and the bridge circuit connected as for to the calibration. Then the lathe was set to operate for contant feed at 0.0078 in./rev. and depthof cut at 0.015 in. and speed varied in steps over range of 15-400 ft./min. by selecting suitable turning speeds and specimen diameters, and F_c and F_t for each speed was measured, Then the results were plated in the form of graphs and two curves were obtained, F_c v.s. cutting speed and F_t v.s. cutting speed.

(F_c = cutting force or vertical force, and F_t = thrust force or horizontal force.)

b. Constant speed test The apparatus was set and the readings were taken as in series 3a, but the cutting speed was kept constant at 250 ft./min. and the feed was varied in steps over range of 0.0045 in./rev. to 0.0124 in./rev. Two curves were obtained, these being F_c v.s. feed/rev. and F_t v.s. feed/rev.

SERIES IV

The tests of series 3a and 3b were repeated, but a cutting fluid was used.

SERIES V Cutting ratio measurement

The specimen was slotted longitudinally and the slot filled with a piece of brass to prevent shock load on the cutting tool during a cut. The lathe was operated at the same dept of cut, feed/rev. and speed as in series 3a, & at each step of speed, one revolution chips were kept and their length measured by rolling them on a straight line in soft paper and measuring the length of their marks on the soft paper.

and from

$$l_1 A_1 \rho_1 = l_2 A_2 \rho_2$$

assume density of metal unchanged during cut.

$$\therefore \rho_1 = \rho_2$$

l_1 = length of specimen circumference ($\pi D - \frac{1}{8}$) in.
(width of slot = $\frac{1}{8}$ in.)

A_1 = cross-section and of chip before cut.
(dept of cut X feed/rev.)

l_2 = one revolution chip length.

A_2 = cross-section area of chip.

$$\therefore \frac{A_1}{A_2} = \frac{l_2}{l_1} = \text{area ratio}$$

Then a curve of $\frac{A_1}{A_2}$ v.s. cutting speed was obtained.

<u>SERIES VI</u> <u>Vibration tests</u>

a. The purpose of this test was to measure the amplitude of vibration of the tool holder at various cutting speeds, the dynamometer was clamped on the saddle of the lathe as before, and a capacitive measuring probe was rigidly clamped to the dynamometer body. The probe face was placed close to the tool tip at a distance of approximately 0.006 in. and one end of the probe was connected to a Wayne Kerr vibration meter.

Using the dynamometer as in the series 3 tests, cutting speed was varied and amplitude noted.

b. The dynamometer was clamped rigidly on a steel table, and the end of the tool holder was connected to a Goodman magnetic vibrator of variable frequency. The frequency was varied until maximum amplitude was obtained. This frequency represents the natural frequency of the dynamometer, when a suitable correction has been made for the mass of the connecting link and the mass of the moving part of the vibrator.

The natural frequency of the tool holder obtained by this method was 980.c/s and the apparatus is shown in Fig 4.4

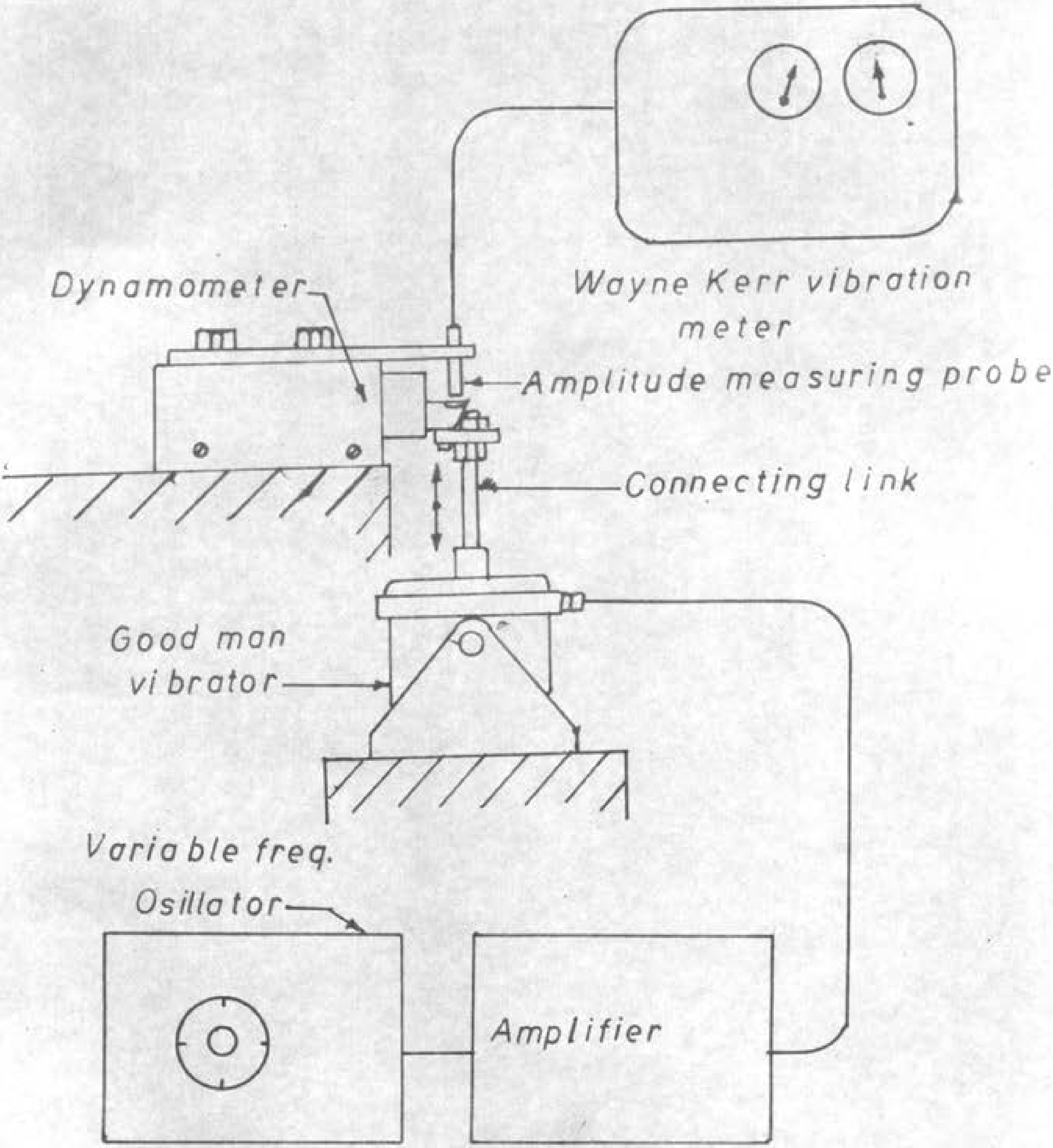

FIG. 4.4 NATURAL FREQUENCY TESTING APP.